

Claims:

1. A tubing injector for injecting coiled tubing into a subsea wellhead or flowline, comprising:

5 a traction device including a plurality of opposing grippers carried on respective opposing chain loops for gripping engagement with the coiled tubing and longitudinally movable with the coiled tubing;

a plurality of outboard bearing assemblies for guiding movement of the opposing chain loops;

10 a drive unit for powering the opposing chain loops to move the chain loops and the grippers carried thereon, the drive unit including a sealed gear case; and

a pressure compensator in communication with the sealed gear case, the pressure compensator responsive to subsea pressure, such that pressure within the sealed gear case is functionally related to subsea pressure.

15 2. A tubing injector as defined in Claim 1, further comprising:

the pressure compensator being in communication with one or more of the outboard bearing assemblies, such that pressure within the one or more compensated outboard bearing assemblies is functionally related to subsea pressure.

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3. A tubing injector as defined in Claim 1, wherein the pressure compensator further comprises:

25 a compensator housing structurally separate from the gear case and bearing assemblies and having a sealed internal cavity in communication with the sealed gear case;

a movable element within the compensator housing responsive to subsea pressure for varying a volume of the internal cavity; and

a biasing member for biasing the movable element.

30 4. A tubing injector as defined in Claim 3, wherein the biasing member biases the movable element to increase pressure.

5. A tubing injector as defined in Claim 1, further comprising:

a conduit extending between the pressure compensator and the sealed gear case for placing the pressure compensator in fluid communication with the sealed gear case.

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6. A tubing injector as defined in Claim 2, further comprising:

a conduit extending between the pressure compensator and the one or more outboard bearing assemblies, for placing the pressure compensator in direct fluid communication with the bearing assemblies.

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7. A tubing injector as defined in Claim 2, further comprising:

a conduit extending between the sealed gear case and the one or more outboard bearing assemblies, for placing the pressure compensator in indirect fluid communication with the bearing assemblies.

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8. A tubing injector as defined in Claim 1, wherein the plurality of bearing assemblies further comprises:

first and second pairs of bearing assemblies, each pair for guiding movement of a respective one of the opposing chain loops.

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9. A tubing injector as defined in Claim 1, wherein one or more of the plurality of bearing assemblies further comprises:

a pressure compensator including a movable element movable within a bore of a bearing shaft, the bore in fluid communication with a bearing cavity containing a lubricant within the bearing assemblies, the movable element exposed on an inner surface to the lubricant and on an outer surface to subsea pressure.

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10. A tubing injector for injecting coiled tubing into a subsea wellhead or flowline, comprising:

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a traction device including a plurality of opposing grippers carried on respective opposing chain loops for gripping engagement with the coiled tubing and longitudinally movable with the coiled tubing;

a plurality of outboard bearing assemblies for guiding movement of the
5 opposing chain loops;

a drive unit for powering the opposing chain loops to move the chain loops and the grippers carried thereon and thereby move the coiled tubing; and

a pressure compensator in communication with one or more of the plurality of bearing assemblies, such that pressure within the sealed cavities is
10 functionally related to subsea pressure.

11. A tubing injector as defined in Claim 10, wherein the pressure compensator comprises:

a compensator housing structurally separate from the plurality of outboard
15 bearing assemblies and having a sealed internal cavity in communication with the one or more of the outboard bearing assemblies; and

a movable element within the internal cavity responsive to subsea pressure for varying a volume of the internal cavity.

20 12. A tubing injector as defined in Claim 11, wherein the pressure compensator further comprises:

a biasing member for biasing the movable element.

25 13. A tubing injector as defined in Claim 10, wherein one or more of the plurality of bearing assemblies further comprises:

the pressure compensator includes a movable element movable within a bore of a bearing shaft, the bore in fluid communication with a bearing cavity containing a lubricant within a bearing assembly, the movable element exposed on an inner surface to the lubricant and on an outer surface to subsea pressure.

14. A tubing injector as defined in Claim 13, wherein the movable element comprises:

one of a piston and a diaphragm sealed with the bore of the bearing shaft.

5 15. A tubing injector for injecting coiled tubing into a subsea wellhead or flowline, comprising:

a traction device including a plurality of opposing grippers carried on respective opposing chain loops for gripping engagement with the coiled tubing and longitudinally movable with the coiled tubing;

10 two pairs of outboard bearing assemblies, each pair for guiding movement of a respective chain loop;

a drive unit for powering the opposing chain loops to move the chain loops and the grippers carried thereon, the drive unit including a sealed gear case; and

15 one or more pressure compensators in communication with the sealed gear case and each of the pairs of outboard bearing assemblies, the one or more pressure compensators responsive to pressure of the subsea environment, such that pressure within the sealed gear case and the bearing assemblies is functionally related to subsea pressure.

20 16. A tubing injector as defined in Claim 15, wherein one or more of the pressure compensators comprises:

a compensator housing structurally separate from the gear case and bearing assemblies and having a sealed internal cavity in communication with the sealed gear case; and

25 a movable element within the internal cavity responsive to subsea pressure for varying the internal pressure.

17. A tubing injector as defined in Claim 16, further comprising:

a spring for biasing the movable element to increase the internal pressure.

18. A tubing injector as defined in Claim 15, wherein one or more of the pressure compensators further comprises:

5 a pressure compensator including a movable element axially movable within a bore of a bearing shaft, the bore in fluid communication with a bearing cavity containing a lubricant within the bearing assemblies, the movable element exposed on an inner surface to the lubricant and on an outer surface to subsea conditions.

19. A tubing injector as defined in Claim 18, wherein the movable
10 element comprises:

one of a piston and a diaphragm sealed with the bore of the bearing shaft.

20. A tubing injector as defined in Claim 15, wherein air within the one or more pressure compensators, the sealed gear case, the bearing assemblies,
15 and passageways therebetween is substantially evacuated and replaced with lubricant, such that the one or more pressure compensators may control pressure on the lubricant to be greater than, less than, or substantially equal to subsea pressure.